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RESEARCH NOTE

SOME OBSERVATIONS ON COYOTE FOOD HABITS IN PENNSYLVANIA[1]

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ABSTRACT

We analyzed 310 coyotes (*Canis latrans*) scats collected in Pennsylvania during April-August 1991-92. Based on frequency of occurrence, white-tailed deer (*Odocoileus virginianus*) (55.2%) were the most common prey or scavenged item. Murid rodents (mice/voles) (14.8%) were the next most common mammalian prey group, followed by cottontail rabbits (*Sylvilagus spp.*) (9.4%) and woodchucks (*Marmota monax*) (9.4%). Insects (18.1%) were also common in the scats; birds (11.9%) were less so. Plant materials of various types were found in 52.3% of the scats. Reptilian/amphibian remains were rare, and livestock remains were not found. Some regional differences in food habits were observed: e.g., deer were more common in the diets in northcentral and northeastern parts of the state than in the southcentral.
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INTRODUCTION

The eastern coyote (*Canis latrans*) has become common and widespread in the eastern United States and Canada because of niches vacated by wolves (*Canis lupus*), mountain lions (*Felis concolor*) and lynx (*Felis lynx*), and alterations of habitat by humans (Chambers 1987, Moore and Parker 1992). We documented increasing numbers and distribution of coyotes in Pennsylvania (Witmer and Hayden 1992). Although the eastern coyote is believed to feed primarily on white-tailed deer (*Odocoileus virginianus*) and lagomorphs (*Lepus americanus* and *Sylvilagus* spp.) (Major and Sherburne 1987, Litvaitis and Harrison 1989, Harrison 1992, O'Connell et al. 1992), there is concern about the potential for significant impacts by coyotes on sheep and other livestock (Slate 1987, Hilton 1992, Witmer and Hayden 1992). Substantial livestock losses to coyotes have been documented in New York (Tomsa and Forbes 1989) and other parts of the United States (USDA 1991, Connolly 1992a, 1992b).

Additionally, hunters have expressed concern that the growing coyote population may be negatively impacting game populations (Wm. Palmer, pers. commun.). Some medium-sized game species (e.g., lagomorphs and grouse [*Bonasa umbellus*]) have shown up in food habit studies, but the coyote has a diversified diet (Major and Sherburne 1987, Litvaitus and Harrison 1989, O'Connell et al. 1992). In Pennsylvania, populations of many game species (cottontail rabbits, turkey [*Meleagris gallopavo*], white-tailed deer) are stable or increasing, despite the growing coyote population (A. Hayden, unpubl. data). This has been noted for white-tailed deer in other northeastern states (Ellingwood and Caturano 1988). In terms of wildlife management, it could be beneficial in some areas of Pennsylvania if coyotes helped reduce some locally over-abundant white-tailed deer populations (Witmer and deCalesta 1992). High densities of white-tailed deer can alter plant communities and adversely affect biodiversity (deCalesta 1994).

There are no published coyote food habits studies from Pennsylvania. The objective of this study was to provide a description of coyote food habits from several regions of Pennsylvania. The study was supported by grants from the Pennsylvania Game Commission and Pennsylvania State University. Gordon Kirkland assisted in preparation of the reference bone collection.

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METHODS

Two hundred and sixteen scats were collected during April-July 1991 from three regions of Pennsylvania: north-central (Cameron, Clearfield, Elk, and Jefferson counties), northeast (Sullivan and Wyoming counties), and south-central (Franklin County). An additional 94 scats were collected from the northeast (Wyoming County) during April-August 1992. We collected scats while walking or slowly driving along dirt or gravel roads. Low densities of bobcats (*Felix rufus*) coexist with coyotes in the northcentral region. Consequently, we discarded some scats that were smaller and more segmented than most coyote scats because they may have been from bobcats. All collection areas were managed forestlands or mixes of agricultural lands and managed forestlands.

Scats were individually placed in paper bags, labeled, and dried at room temperature or, when possible, in an oven at 60°C for two days. A sample of hair from each scat was set aside for later identification. Keys/references used for the identification of hair included Keogh (1983), Novak et al. (1987), and Moore (1988). The remainder of each sample was immersed in an 8% NaOH solution overnight to dissolve hair and other debris, leaving bone, nail, and tooth fragments for identification of prey species (Green et al. 1986). A reference collection of bone and hair from potential prey species was used to aid in the identification of prey items in scats as well as dental formulas (Merritt 1987).

Mammalian prey items were classified to genera or species when possible. Much less effort was made to identify bird, reptilian-amphibian, or insect and plant genera/species in scats.

Data are presented as frequency of occurrence in scats (Leopold and Krausman 1986). This method compares well with other methods of dietary analysis from predator scats (Corbett 1989).

RESULTS AND DISCUSSION

Coyotes consumed a variety of food items in Pennsylvania (Table 1). This is not surprising in light of the adaptability of the coyote as a hunter and scavenger (Bekoff 1982), and the diversity of potential prey available in mixed forest-agricultural lands (Pekins 1992). Remains of at least 12 mammalian genera were identified. These ranged in size from small (mice/voles) to large (white-tailed deer). Our results are similar to those reported by Major and Sherburne (1987) in western Maine and Litvaitus and Harrison (1989) and O'Connell et al. (1992) in eastern Maine, except that snowshoe hares (relatively rare in Pennsylvania) were not identified in our study. Overall, white-tailed deer were the dominant prey or scavenged item, occurring in over half of the scats examined (Table 1). That white-tailed deer were a dominant food item is not surprising, given their high density in Pennsylvania, the large number killed on highways each year, and the large number killed or wounded but not retrieved by hunters (Merritt 1987, Kirkland 1989, Witmer and deCalesta 1992). White-tailed deer were also an important food species of coyotes in other parts of the northeastern U.S. (Major and Sherburne 1987, Litvaitus and Harrison 1989, Harrison 1992, O'Connell et al. 1992). After white-tailed deer, the mice/vole group occurred in about 15% of the scats examined, followed by cottontail rabbits and woodchucks, each at about 9% (Table 1). All are common and widespread in Pennsylvania (Merritt 1987, Kirkland 1989). Some mammals that one might expect to occur (snowshoe hare and Alleghany woodrat [*Neotoma magister*]) were not found, perhaps because these species have become rare in Pennsylvania (Merritt 1987, Kirkland 1989).

Besides mammals, other animals formed a substantial portion of items in coyote scats, particularly birds and insects (Table 1). Across regions, bird feathers and/or egg shell fragments occurred in over 10% of scats examined, and insect material in about 18% of scats examined. Reptile and amphibians, on the other hand, were uncommon in the diet (Table 1).

Plant materials were also common, occurring in 50% or more of the scats. Fruits were identified in nearly 16% of scats (Table 1). Other studies have found fruits to be important in coyote diets in late summer/fall (Witmer and deCalesta 1986, Major and Sherburne 1987, Litvaitus and Harrison 1989, O'Connell et al. 1992), but our results suggest that plant material may be more important in Pennsylvania coyote diets throughout spring and summer as well.

We did not find evidence of livestock (cattle, sheep) in the scats examined. There are at least two explanations for this result. First, areas searched for scats were predominantly public forestlands and other areas where livestock grazing was relatively uncommon. Additionally, because non-livestock food items are abundant, coyotes are not yet keying in on livestock as a potential food source. A recent survey of Pennsylvania sheep growers suggests that livestock are not important prey to coyotes (Witmer et al. IN PRESS).

There were also some regional differences apparent in the coyote scats examined (Table 1). While white-tailed deer were dominant prey or scavenged items in the northcentral and northeastern regions of Pennsylvania, they were much less so in the southcentral region of the state despite a high white-tailed deer density at the Letterkenny Army Depot where we collected the scats (Palmer et al. 1994). In the southcentral regions, rabbits and woodchucks, insects, and plant materials occurred more frequently in the coyote diet. Birds were more common in the diet in the northeastern and southcentral regions than in the northcentral region. This variation may reflect local differences in abundance (or availability) of diverse prey resources within the state.

TABLE 1. Food habits of coyotes in three regions of Pennsylvania, 1991-1992, expressed as frequency of occurrence (%).

Food Item	Northcentral 1991			Southcentral 1991	Northeast 1991-92			Total 1991-92
	Clearfield, Jefferson (n = 12)[a]	Cameron, Elk (n = 63)	Regional Total (n = 75)	Franklin (n = 110)	Sull./Wy. (1991) (n = 31)	Wyoming (1992) (n = 94)	Regional Total (n = 125)	(n = 310)
White-tailed deer (*Odocoileus virginianus*)	91.7[b]	71.4[c]	74.7	28.2	67.7	70.2	69.6	56.1
Mouse/Vole (*Peromyscus spp./Microtus spp.*)	0.0	15.9	13.3	12.7	25.8	14.9	17.6	14.8
Cottontail rabbit (*Sylvilagus spp.*)	0.0	4.8	4.0	14.5	6.4	8.5	8.0	9.4
Woodchuck (*Marmota monax*)	8.3	6.3	6.7	22.7	3.2	2.1	2.4	10.6
Squirrel (*Tamiasciurus hudsonicus*) (*Sciurus spp.*)	0.0	7.9	6.7	5.4	0.0	5.3	4.0	5.2
Raccoon (*Procyon lotor*)	0.0	3.2	2.7	10.9	3.2	1.1	1.6	5.2
Porcupine (*Erethizon dorsatum*)	8.3	1.6	2.7	6.4	0.0	0.0	0.0	2.9
Gray Fox (*Urocyon cinereoargenteus*)	0.0	1.6	1.3	2.7	3.2	1.1	1.6	1.9
Beaver (*Castor canadensis*)	0.0	0.0	0.0	0.0	6.4	2.1	3.2	1.3
Muskrat (*Ondatra zibethicus*)	0.0	1.6	1.3	0.9	0.0	0.0	0.0	0.6
Unidentified hair (Mammalian)	0.0	11.1	9.3	25.4	32.2	12.8	17.6	18.4
Feathers	0.0	4.8	4.0	10.9	12.9	13.8	13.6	10.3
Egg fragments	0.0	1.6	1.3	4.5	0.0	0.0	0.0	1.9
Reptile/Amphibian	0.0	1.6	1.3	4.5	0.0	0.0	0.0	1.9
Insects	16.7	7.9	9.3	38.2	16.1	2.1	5.6	18.1
Grass/sedge	33.3	25.4	26.7	64.5	41.9	6.4	15.2	35.5
Leaf fragments[d]	50.0	23.8	28.0	6.4	41.9	6.4	15.2	15.2
Twigs/bark	25.0	11.1	13.3	2.7	19.4	1.1	5.6	6.4
Seeds/fruit	58.3	20.6	26.7	10.0	35.5	7.4	14.4	15.8
Other plant parts[e]	0.0	3.2	2.7	3.6	6.4	1.1	2.4	2.9
Manmade materials[f]	0.0	4.8	4.0	2.7	3.2	0.0	0.8	2.3

[a]n = number of scats examined
[b]Percent occurrence in scat
[c]May include elk
[d]Woody species only
[e]Nonwoody species
[f]String/twine, aluminum foil, glass, carpet, paper

LITERATURE CITED

Bekoff, M. 1982. Coyote. Pages 447-459 *in* J.A. Chapman and G.A. Feldhamer, eds. Wild mammals of North America. Johns Hopkins Univ. Press, Baltimore, MD.

Chambers, R.C. 1987. Status of the coyote in the northeastern United States. Proc. East. Wildl. Damage Control Conf., 3:318-319.

Connolly, G. 1992a. Coyote damage to livestock and other resources. Pages 161-169 *in* A.H. Boer, ed. Ecology and management of the eastern coyote. Wildlife Research Unit. Univ. of New Brunswick, Fredericton, NB, Canada.

_____. 1992b. Sheep and goal losses to predators in the United States. Proc. East. Wildl. Damage Control Conf., 5:75-82.

Corbett, L.K. 1989. Assessing the diet of the dingoes from feces: A comparison of methods. J. Wildl. Manage., 53:343-346.

deCalesta, D.S. 1994. Effect of white-tailed deer on songbirds within managed forests in Pennsylvania. J. Wildl. Manage., 58:711-718.

Ellingwood, M.R. and S.L. Caturano. 1988. An evaluation of deer management options. Publ. No. DR-11. Conn. Dept. of Environ. Protection, Hartford. 12 pp.

Green, G.A., Witmer, G.W. and D.S. deCalesta. 1986. NaOH preparation of mammalian predator scats for dietary analysis. J. Mammal., 67:742.

Harrison, D.J. 1992. Social ecology of coyotes in northeastern North America: Relationships to dispersal, food resources, and human exploitation. Pages 51-72 *in* A.H.

Boer, ed. Ecology and management of the eastern coyote. Wildlife Research Unit. Univ. of New Brunswick, Fredericton, NB, Canada.

Hilton, H. 1992. Coyotes in Maine: A case study. Pages 183-194 *in* A.H. Boer, ed. Ecology and management of the eastern coyote. Wildlife Research Unit. Univ. of New Brunswick, Fredericton, NB, Canada.

Keogh, H.J. 1983. A photographic reference system of the microstructures of the hair of southern African bovids. African J. Wildl. Res., 13:89-132.

Kirkland, G.L. Jr. 1989. Mammals. Pages 66-67 *in* D.J. Cuff, W.J. Young, E.K. Muller, et al., eds. Atlas of Pennsylvania. Temple Univ. Press, Philadelphia.

Leopold, B.D. and P.R. Krausman. 1986. Diets of 3 predators in Big Bend National Park, Texas. J. Wildl. Manage., 50:290-295.

Litvaitis, J.A. and D.J. Harrison. 1989. Bobcat-coyote niche relationships during a period of coyote population increase. Can. J. Zool., 67:1180-1188.

Major, J.T. and J.A. Sherburne. 1987. Interspecific relationships of coyotes, bobcats, and red foxes in western Maine. J. Widl. Manage., 51:606-616.

Merritt, J.F. 1987. Guide to the mammals of Pennsylvania. Univ. of Pittsburgh Press for The Carnegie Museum of Natural History, Pittsburgh, PA. 408 pp.

Moore, J.E. 1988. A key for the identification of animal hairs. J. Forensic Sci. Soc., 28:335-339.

Moore, G.C. and G.R. Parker. 1992. Colonization by the eastern coyote (*Canis latrans*). Pages 21-37 *in* A.H. Boer, ed. Ecology and management of the eastern coyote. Wildlife Research Unit. Univ. of New Brunswick, Fredericton, NB, Canada.

Novak, M., Baker, J.A., Obbard, M.E. and B. Malloch (eds.) 1987. Wild furbearer management and conservation in North America. Ministry of Natural Resources, Toronto, Ontario, Canada, 1,150 pp.

O'Connell, A.F., Harrison, D.J., Connery, B. and K.B. Anderson. 1992. Food use by an insular population of coyotes. NE Wildl., 49:36-42.

Palmer, W.L., Storm, G.L., Quinn, R., Tzilkowski, W.M. and M.J. Lovallo. 1994. Demographic profiles of deer under different management strategies in Pennsylvania. Proceedings, The science of overabundance: the ecology of unmanaged deep populations. Smithsonian Institution, Conservation and Research Park, Front Royal VA. p. 18.

Pekins, P.J. 1992. Winter diet and bioenergetics of eastern coyotes: A review. Pages 87-99 *in* A.H. Boer, ed. Ecology and management of the eastern coyote. Wildlife Research Unit. Univ. of New Brunswick, Fredericton, NB, Canada.

Slate, D. 1987. Coyotes in the eastern U.S.: Status and implications. Proc. East. Wildl. Damage Control Conf., 3:325-326.

Tomsa, T.N. and J.E. Forbes. 1989. Coyote depredation control in New York—an integrated approach. Proc. East. Wildl. Damage Control Conf., 4:75-86.

United States Department of Agriculture. 1991. Sheep and goat predator loss. National Agricultural Statistics Service, Washington, D.C. 16 pp.

Witmer, G.W. and D.S. deCalesta. 1986. Resource use by unexploited sympatric bobcats and coyotes in Oregon. Can. J. Zool., 64:2333-2338.

Witmer, G.W. and D.S. deCalesta. 1992. The need and difficulty of bringing the Pennsylvania deer herd under control. Proc. East. Wildl. Damage Control Conf., 5:130-137.

Witmer, G.W. and A. Hayden. 1992. Status of coyotes and coyote depredations in Pennsylvania. Proc. East. Wildl. Damage Control Conf., 5:83-87.

Witmer, G.W., Hayden, A. and M. Pipas. 1995. Predator depredations on sheep in Pennsylvania. Proc. Eastern Wildl. Damage Control Conf., 6:IN PRESS.